

REMARKS

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

Claims 1, 2, 4, 8, 14, 20, 21, and 25 have been canceled.

New claim 27 has been added.

Applicant respectfully submits that the disclosure of Applicant's application provides support for the amendments to the claims. For example, at least paragraph 0058 of Applicant's specification provides support for new claim 27.

This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 11, 13, 18, 23, 24, 26, and 27 are now pending in this application.

Claim Objection

Claim 20 is objected to for containing informalities. Claim 20 has been canceled. Reconsideration and withdrawal of this rejection is respectfully requested.

Rejections under 35 U.S.C. § 103

Claims 1, 2, 4, 8, 11, 13, 14, 18, 20, 25, and 26 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,392,248 to Takahara *et al.* (hereafter "Takahara") in view of U.S. Patent No. 6,429,430 to Sato *et al.* (hereafter "Sato"), U.S. Patent No. 5,545,899 to Tran *et al.* (hereafter "Tran"), U.S. Patent No. 6,384,417 to Okumura *et al.* (hereafter "Okumura"), U.S. Patent No. 6,394,650 to Ohara *et al.* (hereafter "Ohara"), and U.S. Patent No. 5,640,016 to Matsuda *et al.* (hereafter "Matsuda"). This rejection is respectfully traversed.

Claim 11 recites a radiation detector comprising, among other things, a phosphor sheet, the phosphor sheet comprising a support having a sheet shape and a phosphor layer including a layer coated on said support with powder of a rare earth oxysulfide phosphor activated by europium of concentration in a range of 0.01 mol% to 3.5 mol%, wherein the

rare earth oxysulfide phosphor powder has an average particle size in a range of 2 μm to 15 μm , wherein a filling factor of the phosphor powder in the phosphor layer is in a range of 60% to 80%, and the phosphor layer has a thickness in a range of 80 to 300 μm , a photoelectric conversion film on which the phosphor layer of said phosphor sheet is integrally layered and bonded, and a charge information reading section having a plurality of pixels arranged in an array form in contact with said photoelectric conversion film and reading out the electric charges generated on said photoelectric conversion film for each of the plurality of pixels as image signals of the radiation rays, wherein said phosphor layer has a surface bonded onto the photoelectric conversion film by an adhesive that transmits light, wherein the surface has a surface roughness of 0.5 μm or less in average roughness R_a , wherein the surface has been smoothed by a treatment using a metal roll or a metal plate. Claims 11, 13, 18, and 26 depend from claim 11.

By providing a radiation detector with a phosphor layer having a surface bonded onto a photoelectric conversion film by an adhesive that transmits light, with the surface having a surface roughness of 0.5 μm or less in average roughness R_a , light emitted from the phosphor is difficult to scatter when the light is incident on the photoelectric conversion film, which advantageously enhances the definition of X-ray images. This can also apply to light emitted from the phosphor layer and reflected onto the surface of the photoelectric conversion film to thereby become incident light on the photoelectric conversion film. In addition, the phosphor powder of the claimed radiator detector has an average particle size in a range of 2 μm to 15 μm , a filling factor of 60% to 80%, and a smoothed surface to address these surface roughness issues.

Takahara discloses a color light emission sheet 4 that includes a flexible sheet base 6 and a phosphor layer 7 disposed on the sheet 6. See Takahara at col. 7, line 63, to col. 8, line 2.

However, as suggested on page 5 of the Office Action, Takahara does not disclose or suggest that the phosphor layer 7 is bonded onto a photoelectric conversion film by an adhesive that transmits light, as recited in claim 11.

Nor does Takahara disclose or suggest that the phosphor layer 7 includes a powder of a rare earth oxysulfide phosphor activated by europium, that a photoelectric conversion film comprises an amorphous silicon film or a single crystal silicon film, or that a surface of the

phosphor layer bonded to the photoelectric conversion film has a surface roughness of $0.5\ \mu\text{m}$ or less in average roughness R_a , as recited in claim 11. Nor does Takahara disclose or suggest the phosphor powder having a filling factor of 60% to 80% or that the phosphor layer is smoothed by a treatment, as recited in claim 11.

Sato discloses a scintillator panel 2 that includes a scintillator 12, a substrate 10, first transparent organic film 14, a transparent inorganic film 16, and a second transparent organic film 18. See Sato at col. 3, lines 9-32. The scintillator 12 is formed on the substrate 10 and a radiation image sensor 4 is formed by attaching an imaging device 20 to a scintillator panel 2 of the scintillator 12, with a first transparent organic film 14, a transparent inorganic film 16, and a second transparent organic film 18 interposed between the scintillator panel 2 and the imaging device 20. See Sato at col. 3, lines 20-33, and Figures 1 and 2.

However, Sato does not disclose or suggest a phosphor layer formed of a phosphor powder coated layer and that the that phosphor powder coated layer has a surface bonded to a photoelectric conversion film, as recited in claim 11. Nor does Sato disclose or suggest or that a surface of a phosphor layer bonded to the photoelectric conversion film has a surface roughness of $0.5\ \mu\text{m}$ or less in average roughness R_a , as recited in claim 11.

Tran discloses a radiation detection panel 10 that includes a flat substrate 14, individual photosensitive modules 12, a phosphor layer 16, and a protective front plate 18. See Tran at col. 4, lines 58-67. Each module 12 includes silicon photodiodes and thin film transistor (TFT) devices formed on silicon wafers. See Tran at col. 5, lines 29-32. The phosphor layer 16 can include conventional phosphors or pre-structured phosphors, such as gadolinium oxide sulfide doped with terbium or europium, or other phosphors. See Tran at col. 5, lines 59-62.

However, Tran does not disclose or suggest a concentration of 0.01 mol% to 3.5 mol% europium in the gadolinium oxysulfide phosphor, as recited in claim 11. Nor does Tran disclose or suggest that the phosphor layer 16 is formed of a powder layer coated on a support and bonded to a photoelectric conversion film by an adhesive that transmits light, as recited in claim 11. Nor does Tran disclose or suggest an average particle size for phosphor powder, the filling factor for the powder, or that a surface of the phosphor layer bonded to the photoelectric conversion film has been smoothed by an operation, as recited in claim 11. Nor does Tran disclose or suggest that a surface of a phosphor layer bonded to the photoelectric

conversion film has a surface roughness of 0.5 μm or less in average roughness Ra, as recited in claim 11.

Okumura discloses a ceramic scintillator that is produced by sintering particles or a rare earth oxysulfide and heat treating the sintered body. See Okumura at col. 2, lines 59-65; col. 3, lines 2-6; col. 4, lines 50-53; col. 7, lines 2-18. Okumura discloses that a surface roughness Ra of a ceramic scintillator is in a range of 0.01 μm to 0.8 μm .

However, the scintillator of Okumura is a sintered structure that cannot have a surface smoothed by a treatment using a metal roll or a metal plate. Applicant respectfully submits that this feature of a smoothed surface provides structure, namely a surfaced that has been smoothed by a treatment and has the surface roughness recited in claim 11, that is not disclosed or suggested by Okumura. The Office argues on pages 2-3 of the Office Action that this feature regards a product-by-process limitation. Even if this feature regards a product-by-process features, which Applicant does not concede, the Office does not appear to consider the structure of the product that is provided by such a process and whether Okumura provides a product with the same structure, which it does not. A sintered surface cannot be smoothed by a treatment using a metal roll or a metal plate, as recited in claim 11. Therefore, Okumura does not remedy the deficiencies of the other references provided in this rejection.

Ohara discloses phosphor layer including phosphor powder with an average size of 2 μm to 7 μm and a filling factor preferably being not less than 60%. See Ohara at col. 6, lines 50-67.

However, Ohara only discloses a radiographic intensifying screen and a silver halide light sensitive photographic material, not a phosphor powder coated layer bonded to a photoelectric conversion film, as recited in claim 11. Nor does Ohara disclose or suggest an average particle size for phosphor powder, the surface roughness, the filling factor for the powder, or that a surface of the phosphor layer bonded to the photoelectric conversion film has been smoothed by an operation, as recited in claim 11. Nor does Ohara disclose or suggest that a surface of a phosphor layer bonded to the photoelectric conversion film has a surface roughness of 0.5 μm or less in average roughness Ra, as recited in claim 11.

Matsuda discloses an x-ray detector that includes a scintillator 1 and a photodiode 2 that are optically connected by a transparent adhesive 3. See col. 2, line 66, to col. 3, line 3, of Matsuda.

However, Matsuda does not disclose or suggest a phosphor layer bonded to a photoelectric conversion film. Nor does Matsuda disclose or suggest that a surface of a phosphor layer bonded to the photoelectric conversion film has a surface roughness of $0.5\ \mu\text{m}$ or less in average roughness Ra, as recited in claim 11.

For at least the reasons discussed above, the combination of Takahara, Sato, Tran, Okumura, Ohara, and Matsuda does not disclose or suggest all of the features of claim 11. Reconsideration and withdrawal of this rejection is respectfully requested. Furthermore, Applicant respectfully reserves the right to submit evidence and further argue the non-obviousness of the numerical ranges recited in claim 11.

Claims 21-24 are rejected under 35 U.S.C. § 103(a) as being unpatentable Takahara, Sato, Tran, Okumura, Ohara, and Matsuda as applied to claims 1 and 11 above, and further in view of U.S. Patent No. 4,032,791 to Chiola *et al.* (hereafter "Chiola"). This rejection is respectfully traversed. Chiola fails to remedy the deficiencies of Takahara, Sato, Tran, Okumura, Ohara, and Matsuda as discussed above in regard to independent claims 1 and 11, from which claims 21-24 depend. Reconsideration and withdrawal of this rejection is respectfully requested.

New Claim

New Claim 27 depends from claim 11 and is allowable over the prior art for at least the reasons discussed above and for its respective additional recitations.

CONCLUSION

Applicant submits that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.


The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or

even entirely missing or a credit card payment form being unsigned, providing incorrect information resulting in a rejected credit card transaction, or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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